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- 2 -

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5. Modern means of air attack facilitate the use of weapons of mass destruction against any selected point of the globe. For this reason it is fundamental that such enemy means of attack be destroyed. The anti-aircraft weapons of the forces can only fulfil that task if they can destroy every target against which they open fire. These functions are best fulfilled by sub-units of anti-aircraft guided missiles, because tactical and technical data assure high accuracy of fire. (The probability of destroying a target with one rocket very often exceeds not only the probability of destroying the target with one battery, but even with a whole conventional anti-aircraft artillery regiment).
6. Guided anti-aircraft missiles effectively destroy targets flying at speeds of 400 metres and more per second at a height of 20-25 kms. Also the technical characteristics of a group [zespol] of guided anti-aircraft missiles make possible the guidance of fire against manoeuvring targets. It is specially important that the effectiveness of fire of guided missiles is relatively little affected by enemy anti-radar interference.
7. Conventional anti-aircraft artillery in many circumstances is not able to carry out properly the tasks imposed on it, especially as regards firing at targets before their arrival at the probable bomb-release line. Sub-units of anti-aircraft guided missiles can not only fire at a target before its arrival at the above line, but also can destroy it. It follows that anti-aircraft guided missiles are a new type of anti-aircraft weapon making possible the more effective execution of the tasks given to anti-aircraft defences in modern types of combat.
8. Talking of the principles of the use of anti-aircraft guided missiles as ground based means of anti-aircraft defence, it can rightly be said that on account of their tactical and technical properties they constitute the means of "zonal anti-aircraft defence", whereas conventional anti-aircraft artillery was and remains the means of "point anti-aircraft defence".

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- 3 -

9. The principle is still valid of the combined use of army anti-aircraft troops in co-operation with the A.A. forces and resources of the Front, of neighbouring armies and the forces of Home A.A. Defence (OPL OK) operating in the army zone.

10. The designation of the anti-aircraft guided missile as a means of zonal defence arises from its combat properties and the possibility of the use of a unit of anti-aircraft guided missiles for the protection for groups of targets deployed at large distances one from another. There are no such possibilities with conventional anti-aircraft artillery. A unit of anti-aircraft guided missiles used at the level of an army may at the same time protect the following elements of the operational grouping of that army:

- a) the main striking force of an army during the occupation of bases and attack positions as well as during combat;
- b) the main elements of the rear services operating adjacent to the main group;
- c) other elements, such as the command post of the army; junctions and routes of communications, etc.

11. As a result of this possibility of shielding the above mentioned elements an anti-aircraft guided missile unit is a method used by the operational level and for that reason should be directly under the chief of the army anti-aircraft defence. On account of its firing capabilities, an anti-aircraft guided missile unit should operate at full strength, maintaining fire liaison between individual sub-units. To split up the unit to provide protection for different targets, isolated one from the other, is inadvisable.

12. A disadvantageous feature of an anti-aircraft guided missile unit is above all that it has only a limited capability in the sphere of combat with low flying targets. That is why it should be used together with small calibre

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- 4 -

anti-aircraft artillery. As far as possible, a battery of small calibre anti-aircraft artillery should be used as protection for the fire sub-units of an anti-aircraft guided missile unit. It is possible to allocate to an army operating on the main axis of attack of the Front, for the period of the operation one, or in exceptional circumstances two, units of anti-aircraft guided missiles. If the army receives as reinforcement a unit of anti-aircraft guided missiles, it can use it as protecting cover for ground forces and other important targets in a zone with a width and depth of 50 - 70 kms. It would therefore seem that the most useful employment of the unit is as cover for the main forces of the army deployed on the main axis of attack.

13. Anti-aircraft guided missile units allotted for protection of the main strike groups of the operational formations of the first echelon are not included in the composition of anti-aircraft artillery groups, because the fire capabilities and especially the manoeuvring capabilities of these weapons (anti-aircraft guided missiles and conventional anti-aircraft artillery) are fundamentally different and this does not favour the general execution of tasks. Where, in order to complete certain definite tasks, more than one anti-aircraft guided missile unit is detailed, then it is possible, and indeed necessary, to unite them into an anti-aircraft guided missile group (GPRK), similar to the way that conventional artillery is united.

14. If an anti-aircraft guided missile unit is used in conjunction with conventional anti-aircraft artillery or with sub-units for radio-electronic counter-measures, for the protection of targets in the rear area, for crossings of an operational nature, or for other important targets of the operational rear area, it is possible to join them into so-called anti-aircraft defence groups (GOPL), which are organised on general principles, similarly to Army A.A. Artillery Groups (AGAPlot) and Front A.A. Artillery Groups (FGAPlot).

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- 5 -

15. The composition of the GOPL can be various; it can be composed of an anti-aircraft guided missile unit, one or two regiments of conventional anti-aircraft artillery, or one or two sub-units for radio-electronic counter-measures. All these are subordinate to one commander and carry out jointly any specific task.

#### Combat Grouping

16. The combat grouping of an anti-aircraft missile unit is composed of combat groupings of fire sub-units, the command post and the unit and grouping of the combat technical sub-unit. The combat grouping of an anti-aircraft guided missile unit depends on the combat (operational) grouping of the forces, and should ensure:

- a) the best use of the fire power of the fire sub-units, in accordance with their combat characteristics;
- b) fire co-operation between individual fire sub-units and neighbouring anti-aircraft guided missile units;
- c) the repulsion of enemy air-raids from any direction;
- d) the infliction of losses to the enemy in the air before they reach the bomb release line;
- e) effective command and directing of fire;
- f) the best use of terrain with regard to its cover characteristics.

17. These conditions can be fulfilled by a rational deployment of fire sub-units (spacing, distances) in relation to the forces being protected.

18. The minimum spacing between fire sub-units ought to be such that:

- a) one atomic explosion does not affect simultaneously two fire sub-units;
- b) together they do not cause interference to neighbouring radar stations;
- c) during firing, the falling part of the rocket does not fall on to the combat grouping of a neighbouring fire sub-unit.

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- 6 -

19. Arising from the above, it may be accepted that the minimum spacing between individual fire sub-units should be not less than 5 kms. While determining the extent of the spacing between sub-units one should take into account, above all, the effectiveness of maintaining fire liaison between them, and the mutual overlapping of the beaten zones of the individual fire units.

20. A distance of 30-40 kms. is accepted as a maximum space between batteries. The deployment of fire sub-units at the maximum distances makes it possible for the unit as a whole to fire at only one target. For this reason such a grouping can be used only in exceptional circumstances.

21. Most frequently, medium spacing is suitable between sub-units, but it depends on the type of missiles and their tactical and technical characteristics as well as on the anticipated altitude of the operations of the air means of enemy attack. Medium spacing, for the most part, is from 16 to 20 kms; this ensures mutual overlapping of the beaten zones at all possible heights and in any direction of flight of the target, as well as the destruction of a large number of targets carrying out manoeuvres in the launching area.

22. An anti-aircraft guided missile unit composed of three fire sub-units can be deployed in the shape of a triangle with the apex either in the front or at the rear. The most convenient is a grouping with the apex at the rear.

23. The distances of the fire sub-units of the first line from the forward edge should ensure the destruction of the target before its arrival at the probable bomb release line, and for the fire sub-units - safety from the effect of fire weapons and from observation by the enemy on the ground. The distance (L) is calculated with the help of the formula (Fig. 1):

$$L = R + K - (A + V_c \cdot t)$$

where  $V_c$  means the speed of flight of the target;

$t$  - the time of flight of the target until the moment of its interception by the rocket;

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- 7 -

- K - the line of safe bombing (safety belt);
- A - bombing distance;
- R - the radius of the zone of destruction;
- L - the mean distance from the forward edge;
- PRB - probable bombing line.

24. The mean distance of the first line of the fire sub-units from the forward edge ought to be 18 - 19 kms. and, as a minimum, about 15 kms. During defensive operations fire sub-units should be deployed according to the combat (operational) grouping of the forces to be protected.

25. If the main effort of the forces is to defend the main belt, then the fire sub-units can be deployed at a distance not less than 15 - 18 kms. from the forward line of the defence. In other situations, on account of the restricted capabilities of manoeuvre of the fire sub-units, it is most effective to deploy them in the second defence belt and behind it.

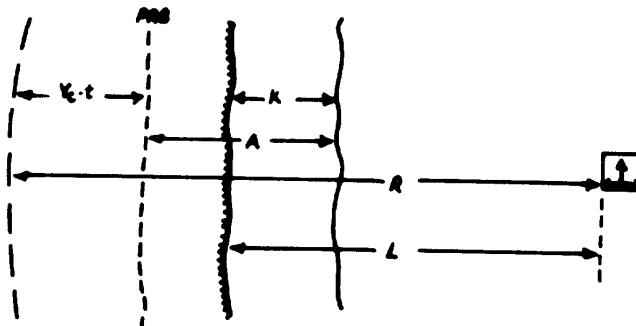


Figure 1.

26. During the selection of a place for the unit Command Post, there ought to be taken into account the possibilities of co-operation with fighter aircraft and conventional anti-aircraft artillery, the convenience of directing the combat of the fire sub-units, as well as the characteristics of the terrain. Generally,

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- 8

during defence, the unit Command Post should be selected close to the second line of sub-units and, in attack, in the middle of the combat grouping of the unit or closer to the fire sub-units of the first line. It is advisable for the unit Command Post to be in the vicinity of the Command Post of the chief of the army anti-aircraft defences.

27. Because the time necessary to deploy and to concentrate the positions of the fire sub-units and the technical sub-unit is relatively long, the manoeuvring capabilities of an anti-aircraft guided missile unit are limited. It is therefore desirable that attacking forces be protected as long as possible by fire sub-units of the first line without any changes in their fire positions.

28. In attack it is possible to deploy the fire sub-units of the first line closer to the forward edge than in defence. An enemy in defence has smaller capabilities of operation with his own surface fire weapons against the fire sub-units than when going over to the attack, because in defence he will have at his disposal a considerably smaller number of fire weapons than at a time of entry into battle. Furthermore, the operations of air means of enemy attack in defence will be considerably less than in attack. This permits a reduction of fire and thereby concealment of the fire sub-units of the first line from enemy reconnaissance until the beginning of active operations by his aircraft, which as a rule follows the entry of our forces into attack.

29. On the basis of these arguments, the conclusions can be drawn that fire sub-units of the first line designed to protect the forces which are in the attack position must be deployed at distances not greater than 10 - 15 kms.

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- 9 -

The Movement of an Anti-Aircraft Guided Missile Unit

30. When considering the possibilities of moving an anti-aircraft guided missile unit in attack, we must take into consideration:

- a) a unit grouped into two lines of fire sub-units (in the first line - two fire sub-units, in the second - one or two);
- b) the distance of the fire sub-units of the first line from the forward edge is 10 kms., the second line of sub-units is at a distance of 15 kms. from the first;
- c) the anticipated mean rate of attack of the forces being protected is 3 kms. per hour;
- d) the average marching speed of a fire sub-unit is 15 kms. per hour;
- e) the time for deploying the fire position is 6 hours, and for concentrating [zwijac] - 3 hours.

31. The fire sub-unit can move to the area of the new fire position only when its own forces are at a distance of around 5 kms. In the first sequence one must move the fire sub-units of the second line.

32. In order to determine the possibilities of sustained protection of the attacking forces by one unit of anti-aircraft guided missiles, we must carry out the necessary calculations.

33. The troops are protected from enemy air-raids by the guided missile unit, if they are in the beaten zone not closer than 10 kms. to its border. During bombing from medium heights in direct combat with the enemy, the depth of the "safety zone" will be not less than 5 kms. Then the leading units of our troops, being at a distance of 5 kms. from the border of the beaten zone, will equally not be within range of attack from the air. When our own troops are advancing to the above mentioned line, the fire sub-unit ought to be ready to fire in a new fire position with a view to assuring continual protection.

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- 10 -

34. Let us determine where the fire position can be and when it ought to be changed, so that the fire sub-unit may be ready to meet these requirements.

35. The fire sub-unit can enter the fire position area at a time when our own leading sub-units are at a distance of 5 kms. from that area (the distance ensuring safety from observation from the enemy observation post and from fire from its battalion artillery). The fire sub-unit will be ready to fire in that fire position within 6 hours. In that time the attacking forces (at a speed of 3 kms. per hour) will have gone 18 kms. That means that the fire sub-unit will be ready for firing in a fire position 23 kms. ( $5 + 18 = 23$ ) away from the forward units of our forces.

36. Before the newly-moved fire sub-unit is ready for fire at its new fire position, our forces will have covered 18 kms. (in the course of 6 hours). To shift a fire sub-unit in these same conditions takes 10 hours (3 hours for leaving the old fire position + 1 hour on the move, + 6 hours for getting ready in the new fire position). That means that the order to start moving must be given 4 hours before the beginning of the attack.

37. If the fire sub-units were moved in succession, each sub-unit would have to begin moving even before the first sub-unit was ready to fire.

38. The considerations and calculations quoted above show that if the tempo of attack of our forces is 3 kms. per hour, an anti-aircraft guided missile unit cannot ensure continuous protection even when the time for the concentration and deployment of sub-units is reduced to a minimum. Because of this one must accept the principle of "continuous in time" protection of the attacking forces and protect them above all on the tactically and operationally important lines, areas and targets. Furthermore, an anti-aircraft guided missile unit ought not to be moved by fire sub-units (in turn) because of their restricted manoeuvring capabilities. On account of the rapid tempo of attack of the forces, it is best to carry out the move with the whole unit at one time.

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- 11 -

39. In the course of the first day of operations the anti-aircraft guided missile unit can remain in the existing fire position, protecting effectively the main strike groups of the forces in the attack position, and then the tactical formations of the second operational echelon of the army and its reserves during the withdrawal and the move. The first move is best carried out in the second half of the first day of operations or at night at the end of the first and at the beginning of the second day, the point being that, by the morning of D2/D3, the unit should be ready to protect the main body of the forces or the divisions of the second echelon in the new area. The methods of using the anti-aircraft guided missile unit during operations can vary, depending on the importance of the targets protected and the length of time of protection.

40. Because the fire sub-units need a relatively long time to complete their move, and the situation on the battle field, and the tempo of attack can, during that time, undergo great changes in relation to that anticipated, the movement plan (of occupying the precise fire positions as planned) cannot be carried out exactly. If, in planning the move, no account is taken of the possibility of a change in the tempo of attack, the result of a reduction (slowing down) of it can be that the planned fire position area can turn out to be still occupied by the enemy and, as a result of an increase in the tempo of attack, the missile unit might remain far in the rear of the forces to be protected. Because of this the fire positions of fire sub-units being moved must not be fixed in detail, but must be a region of considerable dimensions, with commanders of fire sub-units allowed a choice of fire positions in a radius of 2 - 3 kms. from a designated point. The size 2 - 3 kms., in comparison to the radius of the beaten zone, is relatively insignificant and in practice does not affect the effectiveness of the protection of the forces.

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- 12 -

41. The combat grouping of an anti-aircraft guided missile unit as a screen for targets in the rear is different from the combat grouping of an anti-aircraft artillery group. The latter adopts a combat grouping with the task of protecting from air attacks one, or less frequently, several targets positioned close together. On the other hand, the combat grouping of an anti-aircraft guided missile unit ought to ensure the simultaneous protection of a group of targets of operational importance spread out over a relatively large area. The size of this area will depend, above all, on the fire capabilities and combat characteristics of the rockets forming the armament of the unit, as well as on the nature of the targets to be protected.

42. The combat grouping of an anti-aircraft guided missile unit ought to ensure the destruction of enemy aircraft before they drop their bombs on any protected target as well as the destruction of guided (or free-flight) enemy missiles (provided the speed and ceiling of flight of the missile lie within the combat capabilities of the anti-missile missile concerned) before their appearance above the target.

43. This may be achieved when all protected targets lie within the boundaries of the area of effective protection of the anti-aircraft guided missiles. The boundaries of this area can be determined on the basis of the size of the radius of the zone of protection of the anti-aircraft guided missiles. The radius of the protection area ( $R_{os\perp}$ ) in combat conditions where aircraft are using free-flight air bombs, can be calculated on the basis of the formula:

$$R_{os\perp} = R - (S_{min} + A)$$

where  $R$  - is the radius of the field of fire of the given type of missiles in relation to the height of the anticipated flight of enemy aircraft;

$S_{min}$  - the minimum flight path of the target in the field of fire which guarantees effective damage to that target by the given type of missiles;

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- 13 -

A - the interval of bombing in the given conditions.

44. When using anti-aircraft guided missiles to combat enemy guided missiles of the type "ground to ground" and "air to ground", the radius of the protected area can be calculated on the basis of the formula:

$$R_{\text{osl}} = R - S_{\text{min}}$$

45. It must be stressed that the value of  $S_{\text{min}}$  (the minimum distance to be travelled by the target in the field of fire to ensure effective damage to the target by a given type of rocket) depends on the altitude and speed of flight of the target. The greater the altitude and speed of flight of the target, the greater (apart from certain other conditions) the size of  $S_{\text{min}}$ , especially during firing at enemy guided missiles.

46. The greatest possible number of fire sub-units of anti-aircraft guided missiles must be deployed on the approaches to the most important of the protected targets.

47. The distance of the fire positions of the anti-aircraft guided missile fire sub-units from the most important targets ought to be such that those targets are within the effective zone of protection of several sub-units. Such a deployment of fire sub-units substantially increases the effectiveness of the protection of those targets.

48. The technical sub-unit of the unit is positioned within the boundaries of the combat grouping of the unit taking into consideration the convenience of the supplying rockets to the fire-positions of the fire sub-units.

49. The unit command post should be within the boundaries of the combat grouping of the unit, in the most likely direction of enemy air attacks, but not closer than 3 - 5 kms. from the protected targets.

50. The initial search radar stations of the unit are placed as follows: one in the area of the unit command post, the second not less than 5 kms. from the first, generally on the line of the most probable enemy air-raids.

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- 14 -

March of an Anti-Aircraft Guided Missile Unit

51. A march of an anti-aircraft guided missile unit is organised on general principles, similar to those applicable in conventional anti-aircraft artillery units. When selecting a route, regard should be paid to the following requirements:

- a) bridges should be capable of taking not less than 30 tons;
- b) the radius of the curvature of bends should not be less than 10 m.;
- c) the headroom under bridges and viaducts should be not less than 4 m.

52. Fire sub-units of an anti-aircraft guided missile unit should march by separate routes. With a view to reducing the vulnerability of the column to attack from the air, it should be split up. The distances between motor vehicles (prime movers) ought to be 20 - 30 m., between platoons (groups) up to 50 m. The column can be divided into two echelons (in the first - motor vehicles; in the second - caterpillar tractors). Motor tankers with petrol and missile-fuel move in the tail of the column, and the distance between these vehicles (tankers) should be 200 - 250 m.

53. The march of anti-aircraft guided missile sub-units takes place mostly at night or in daytime under conditions of restricted visibility. When the march is being organised, the technical sub-unit must be sent out in advance so that it can deploy and prepare the missile before the arrival of the fire sub-units to the predetermined area. The speed of march of the anti-aircraft guided missile sub-units which can be achieved is dependent on the capabilities of the tractors, which can display quite a considerable speed; on account of the vulnerability of the equipment to jolting, however, maximum speed should not be developed unless a particular situation demands it.

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